

National Aeronautics and Space Administration



SAGE III
ISS

Stratospheric Aerosol and Gas Experiment

An Earth Science Mission on the International Space Station

Science Team Meeting

NASA Langley Research Center

09/12/2023



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Stratospheric Aerosol and Gas Experiment

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Mission Operations

Jamie Nehrir

Mission Operations Manager





Outline



- **Mission Operation Overview**
- **What Has Change in the Last Year**
- **Future Work**





Ops Overview



➤ Mission Operations Goals

- Commanding and downloading data on a weekly/daily basis
- Maintaining the health and safety of the SAGE III payload
 - Daily engineering checks
 - Trending of engineering data and science metrics
 - Supply contamination data to ISS for a detailed understanding of the space environment
 - Conduct detailed analysis of the Hexapod pointing quaternion to improve pointing accuracy
 - Execute maintenance activities (Boresight alignment analysis, Attenuator mechanism trending, CCD Characterization analysis, Azimuth Range of motion execution)
- Process and distribute SAGE III data
 - Process Ground Support Equipment (GSE) and Solid State Memory Card (SSMC) in near real-time (8-5 ET)
 - Processes 24 hours of SSMC data daily
 - Generates daily SCF files
 - Level 0 and ancillary data
 - Generates daily ESA/TASI Hexapod data files



Ops Team



SAGE III Payload Operations Center

Jamie Nehrir	Mission Operations Manager
Andrew Peterson	Ground System Manager
Greg Paxton	Ground Systems Lead
Samuel Porter	Deputy Mission Operations Manager
Robert Borchardt	Lead Technical Payload Engineer
Jonathan Hicks	Ground Systems Engineer
James Farmer	Ground Systems Engineer
Rick Farmer	Ground Systems Engineer
Joshua McDonald	Payload Engineer
Caitlyn Stone	Payload Engineer
Donald Cleckner	Payload Engineer
James Losey	Payload Engineer



SAGE III Operations



- **SAGE III celebrated its 6th birthday on board the International Space Station**
- **The SAGE III payload continues to operate as expected**
- **SAGE has almost acquired 60,000 occultation events!!**



Phase-E Totals

7/1/2017 00:00 to 9/6/2023 09:00



Event Type	Total Planned	Total Acquired	Total % Acquired (vs. Planned)
Sunrise	31400	28447	90.6%
Sunset	31396	26995	86%
Moonrise	4300	1657	38.5%
Moonset	4544	2639	58.1%
<i>All Occultation</i>	71640	59738	83.4%
Limb	24917	24244	97.3%

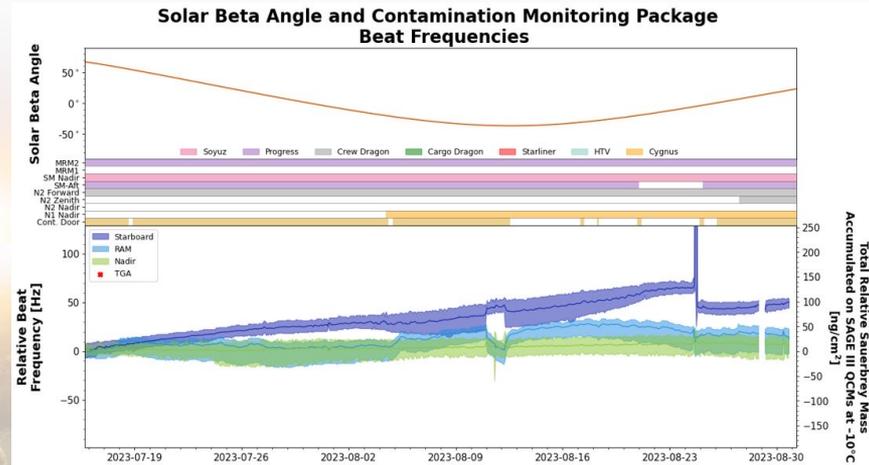
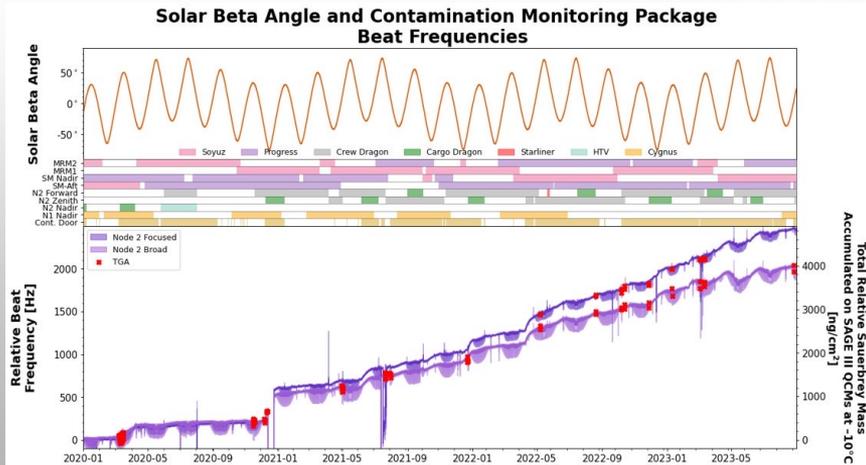


Contamination on ISS



➤ Overall contamination on station has remained consistent over the past 6 years

- Visiting vehicles are the main contributor to contamination and the payload maintains the safety of the internal optics by closing the contamination window while any contamination is being measured by the CMP's
- New solar panels have been slowly added to ISS over the past two years. SAGE has measured a slight increase in contamination on the starboard sensor following the installation of a near by solar panel.





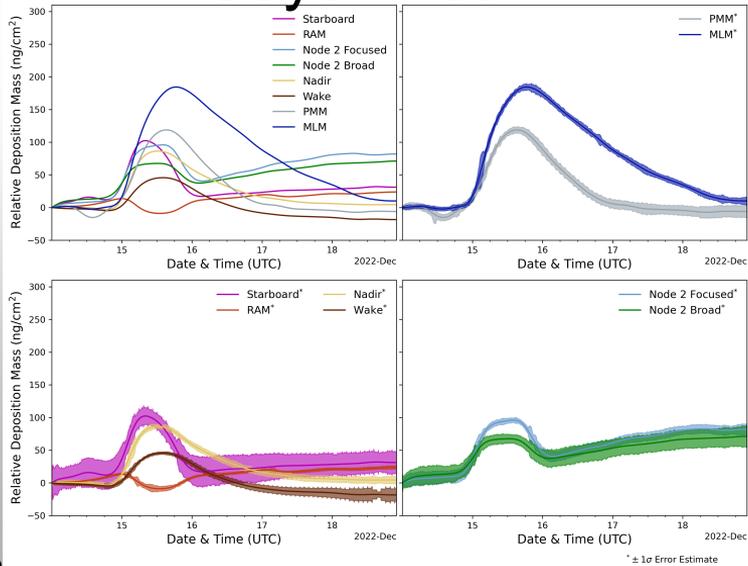
Contamination on ISS Cont.



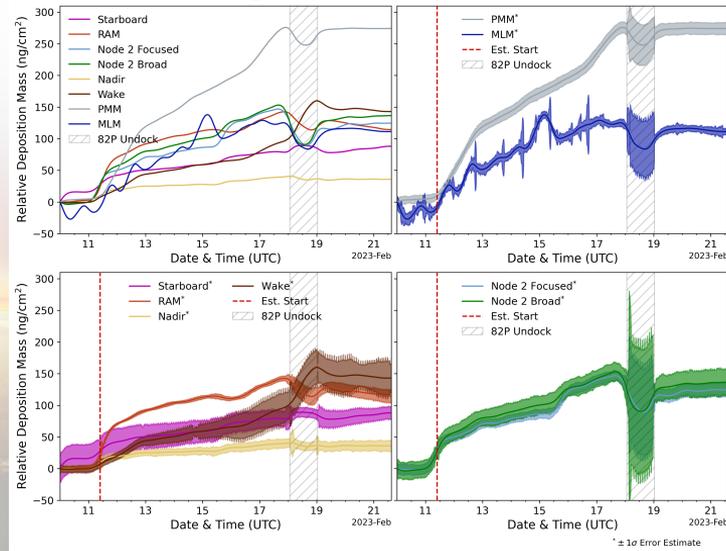
➤ Two unexpected rapid contamination events occurred on station in the past year.

- December 14th, 2022 a Soyuz payload unexpectedly started leaking isoctane. CMP sensors in every direction recorded rapid contamination. By December 15th all sensor started to see desorption.
- February 11, 2023 a Progress payload experienced a similar contamination leak but this time the substance was polydimethylsiloxane which unlike the previous leak did not desorb from any of the sensor surfaces

Soyuz Leak



Progress Leak

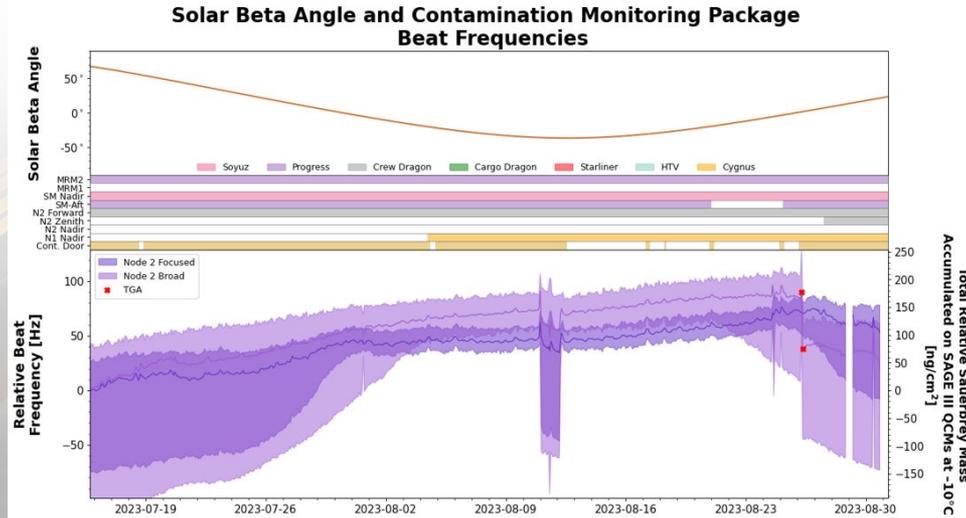




Contamination Cont.



- SAGE III has continued to monitor and assess impacts to thermal control surfaces and the science optical train. At this time no notable changes have been seen.
- The Node2 and Node2 focused facing sensors seem to have plateaued over the last couple of months. The contamination engineer on the operations team is continuing to review the data to determine what addition information can be obtained with this new finding.





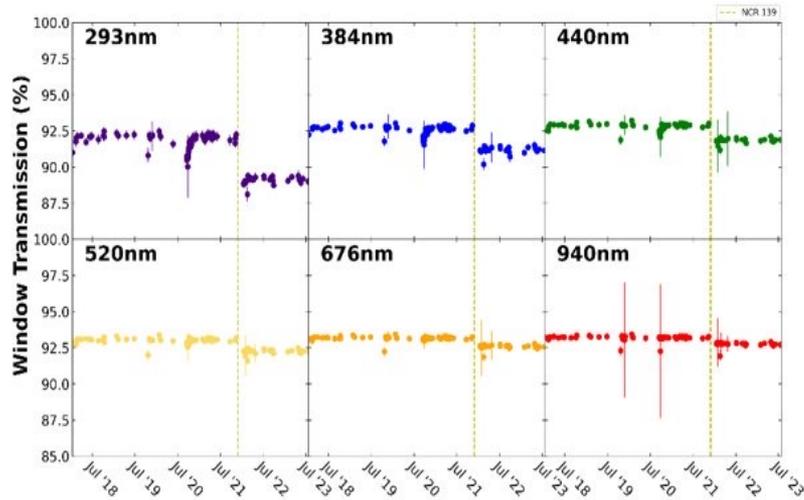
Window Transmission update



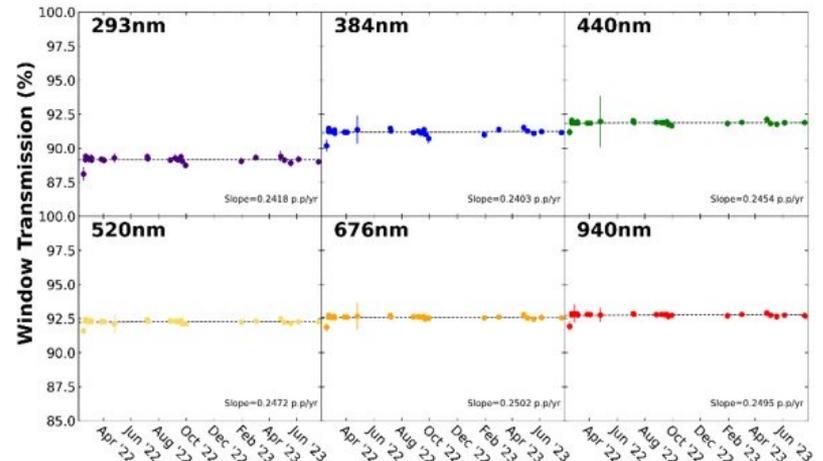
➤ SAGE III Transmission through the contamination window

- As presented last year, a single event impulse contamination event occurred on November 29, 2021. The SAGE III team has continued to monitor the transmission over the past year and no additional degradation has been observed.

Sunrise



Sunrise After 2/1/2022





Limbs Events



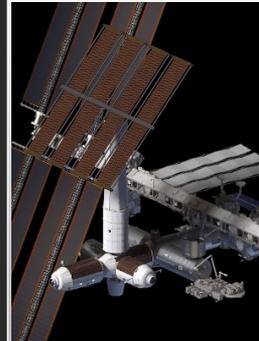
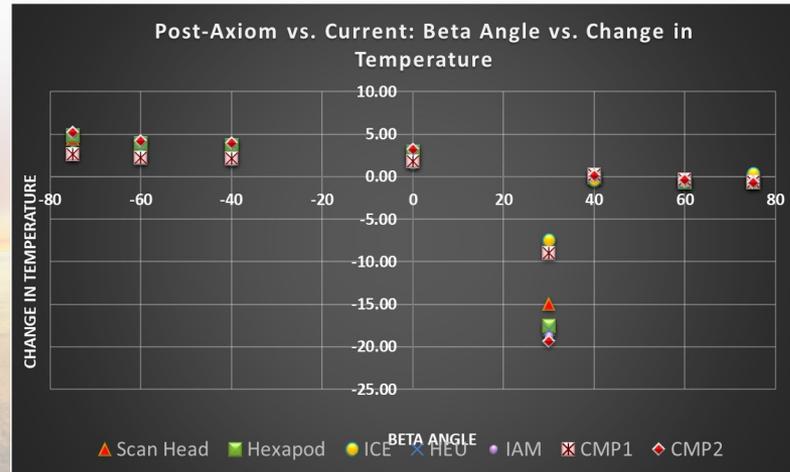
- **The Operations team continues to review hardware capabilities of the SAGE III payload to optimize limb durations**
 - While limb durations will decrease over time as the payload ages (because of thermal constraints on the elevation motor) the operations team performed a review of the wake duration limbs of the last 6 years and determined that there was no longer any thermal differences between wake facing limbs and ram facing limbs resulting in increase durations for ram facing limbs.



Future Work



- The ISS is proposing to add new module called Axiom. The first module will go up in ~2026. SAGE III is actively working with the ISS to determine how the addition of axiom will affect the yaw, pitch and roll of station which could hinder SAGE III's ability to point fully nadir.
 - Detailed analysis was conducted by the SAGE III thermal team, the assessment was performed using the most recent model delivered by the ISS Passive thermal control team.
 - To determine the impact of Axiom a comparison with the current model verses the addition of Axiom was done at different angles.
 - Two main conclusions were made:
 - In the worse case scenario temperatures increased by 5° C
 - At 30 degrees beta there is a significant decrease in temperature because of shading by axiom





Future Work cont.



- **Update Instrument Assembly code to allow for tracking through low orbit clouds.**
 - The SAGE III engineers along with the science team are working to incorporate a new feature, called smart scanning, which would allow for the SAGE III payload to recapture the sun following an obscuration through a cloud.
 - The SAGE III operations team is hoping to load this new feature in December of 2023.



Questions